FM1100 User Manual
v0.07

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1 INTRODUCTION

1.1 Attention

Do not disassemble the device. If the device is damaged, the power supply cables are not isolated or the isolation is damaged, before unplugging the power supply, do not touch the device.

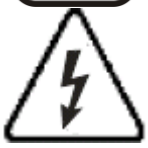
All wireless data transferring devices produce interference that may affect other devices which are placed nearby.

The device must be connected only by qualified personnel.

The device must be firmly fastened in the predefined location.

The programming must be performed using a second class PC (with autonomic power supply).

The device is susceptible to water and humidity.



Any installation and/or handling during a lightning storm are prohibited.

FM1100 has USB interface;
Please use cables provided with FM1100 device.
Teltonika is not responsible for any harm caused by using wrong cables for PC <-> FM1100 connection.

1.2 Instructions of safety

This chapter contains information on how to operate FM1100 safely. By following these requirements and recommendations, you will avoid dangerous situations. You must read these instructions carefully and follow them strictly before operating the device!

The device uses a 9 V...30 V DC power supply. The nominal voltage is 12 V DC. The allowed range of voltage is 9 V...30 V DC.

To avoid mechanical damage, it is advised to transport the FM1100 device in an impact-proof package. Before usage, the device should be placed so that its LED indicators are visible, which show the status of operation the device is in.

When connecting the connection (2x5) cables to the vehicle, the appropriate jumpers of the power supply of the vehicle should be disconnected.

Before dismounting the device from the vehicle, the 2x5 connection must be disconnected.

The device is designed to be mounted in a zone of limited access, which is inaccessible for the operator. All related devices must meet the requirements of standard EN 60950-1.

The device FM1100 is not designed as a navigational device for boats.

1.3 Legal Notice

1.4 About document

This document contains information about the architecture, possibilities, mechanical characteristics, and configuration of the FM1100 device.

Acronyms and terms used in document

PC – Personal Computer.

GPRS – General Packet Radio Service.

GPS – Global Positioning System.

GSM – Global System for Mobile Communications.

SMS – Short Message Service.

AC/DC – Alternating Current/Direct Current.

I/O – Input/Output.

Record – AVL data stored in FM1100 memory. AVL data contains GPS and I/O information

AVL packet - Data packet that is being sent to server during data transmission. AVL packet contains from 1 to 24 records.

2 BASIC DESCRIPTION

FM1100 is a terminal with GPS and GSM connectivity, which is able to determine the object's coordinates and transfer them via the GSM network. This device is perfectly suitable for applications, which need location acquirement of remote objects. It is important to mention that FM1100 has additional inputs and outputs, which let you control and monitor other devices on remote objects. FM1100 also has a USB port for device status log output and entering configurations.

2.1 *Package contents*[1]

The FM1100 device is supplied to the customer in a cardboard box containing all the equipment that is necessary for operation. The package contains:

the FM1100 device;
input and output power supply cable with a 2x5 connection pins;
GPS antenna;
GSM antenna;
USB cable.
Card with link

2.2 *Basic characteristics*

GSM / GPRS features:

- Teltonika TM11Q quad band module (GSM 850 / 900 / 1800 / 1900 MHz);
- GPRS class 10;
- SMS (text, data).

GPS features:

- Skytraq (Venus634LPx chipset) 65 channel receiver;
- Protocol NMEA-0183: GGA, GSA, GSV, RMC, VTG;
- Up to -161 dBm sensitivity.

Hardware features:

- Cortex®-M3 processor;
- 1 MB internal Flash memory;
- Built-in movement sensor.

Interface features:

- Power supply: 9 ÷ 30V;
- USB port;
- digital inputs;
- 1 analog input;
- open collector digital outputs;
- 1Wire® temperature sensor
- 1Wire® iButton
- LEDs indicating device status.

Special features:

- Any element event triggers (external sensor, input, speed, temperature, etc.);
- Highly configurable data acquisition and sending;
- Multiple Geofence areas;
- Deep sleep mode;
- Configurable scenarios available;

[1] Package content depends on Order Code, and can be customized by client needs.

- Real-time process monitoring;
- Authorized number list for remote access;
- Firmware update over GPRS or USB port;
- Configuration update over GPRS, SMS or USB port;
- TCP/IP or UDP/IP protocol support;
- 8000 record storing;

2.3 Mechanical features

Part name	Physical specification
Navigation LED	LED
Modem LED	LED
GPS	GPS antenna connector MCX
GSM	GSM antenna connector SMA female outer shell, female inner pin
Socket 2□5	Tyco Micro MATE-N-LOK™ 4-794628-0 or similar
USB	Mini USB socket

Technical details
Power supply 9...30 V DC 2W Max Energy consumption: GPRS: ⎓ 150 mA r.m.s Max., Nominal: ⎓ average 65 mA r.m.s, Deep Sleep: ⎓ average less than 2 mA[2] Operation temperature: -25°C ... +55°C Storage temperature: -40°C ... +70°C Storage relative humidity 5 ... 95 % (non condensation)

Table 1. FM1100 specifications

[2] When in Deep Sleep mode no data sending and storing is activated.

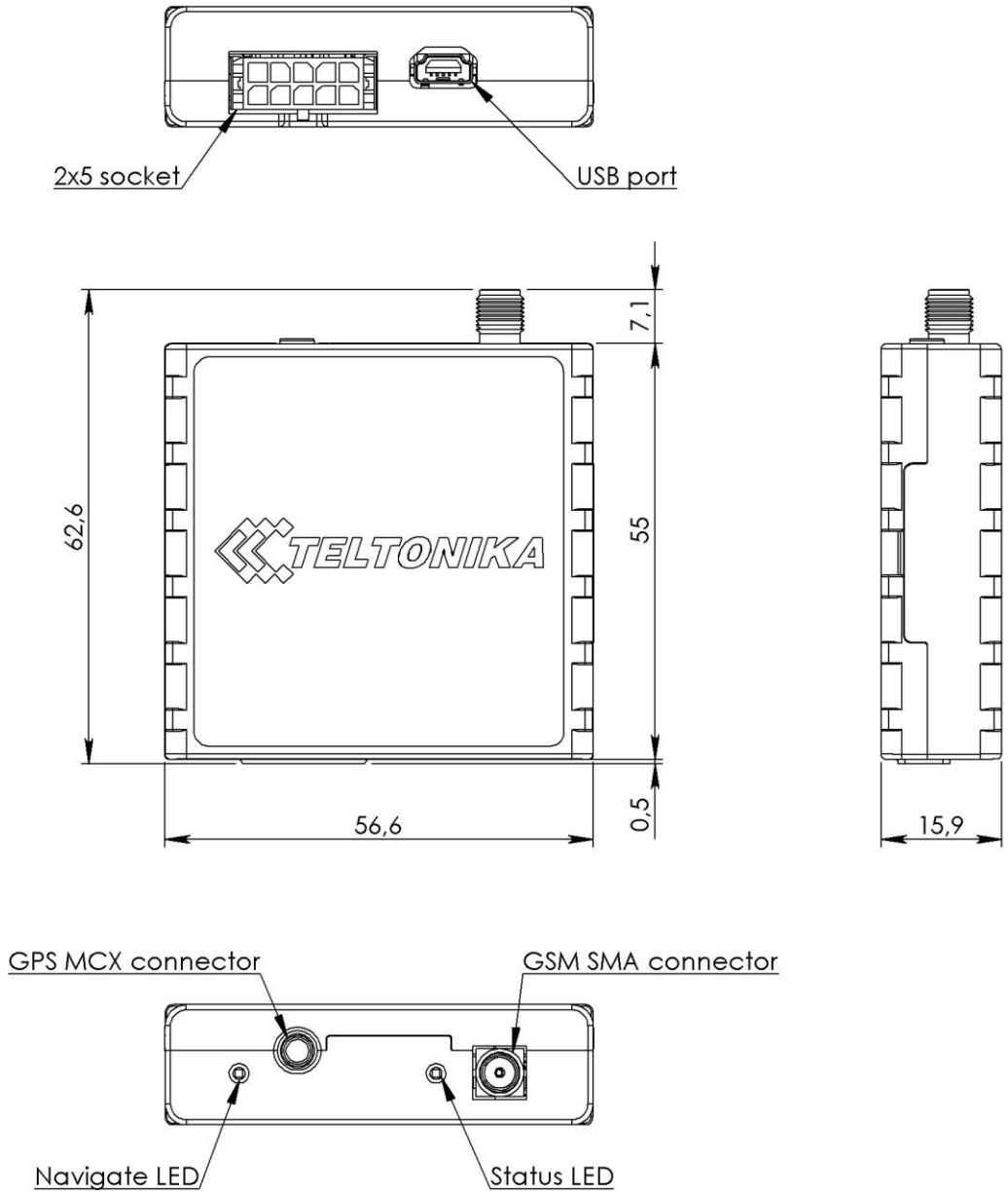


Figure 2. FM1100 view & dimensions (tolerance ±2mm)

2.4 Electrical characteristics

	Min.	Typ.	Max.	Unit
Supply Voltage:				
Supply Voltage (Recommended Operating Conditions)	9		30	V
Digital Output (Open Drain grade):				
Drain current (Digital Output OFF)			120	uA
Drain current (Digital Output ON, Recommended Operating Conditions)			300	mA
Static Drain-Source resistance (Digital Output ON)			300	mOhm
Digital Input:				
Input resistance (DIN1, DIN2, DIN3)	15			kOhm
Input Voltage (Recommended Operating Conditions)	0		Supply voltage	V
Input Voltage threshold (DIN1)		7,5		V
Input Voltage threshold (DIN2, DIN3)		2,5		V
Analog Input:				
Input Voltage (Recommended Operating Conditions), Range1	0		10	V
Input resistance, Range1		120		kOhm
Input Voltage (Recommended Operating Conditions) Range2	0		30	V
Input resistance, Range2		146,7		kOhm
Output Supply Voltage 1-Wire:[3]				
Supply Voltage	3,3		3,6	V
Output inner resistance		7		Ohm
Output current (U_{out} > 3.0V)		30		mA
Short circuit current (U_{out} = 0)		130		mA

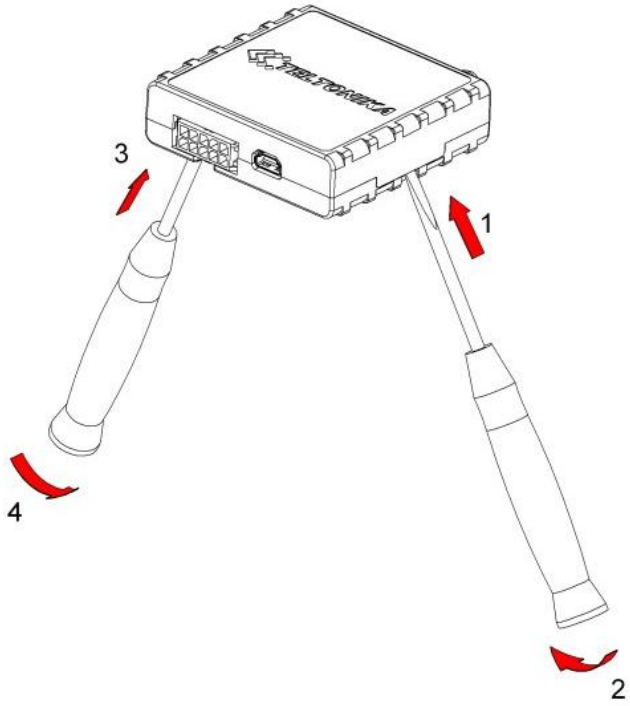
2.5 Absolute Maximum Ratings

Supply Voltage (Absolute Maximum Ratings)	-32		32	V
Drain-Source clamp threshold voltage (Absolute Maximum Ratings), (I_{drain} = 2mA)			36	V
Digital Input Voltage (Absolute Maximum Ratings)	-32		32	V
Analog Input Voltage (Absolute Maximum Ratings)	-32		32	V

[3] 1-wire Supply voltage PIN is dedicated for 1-wire devices ONLY, do not use it for any other purpose.

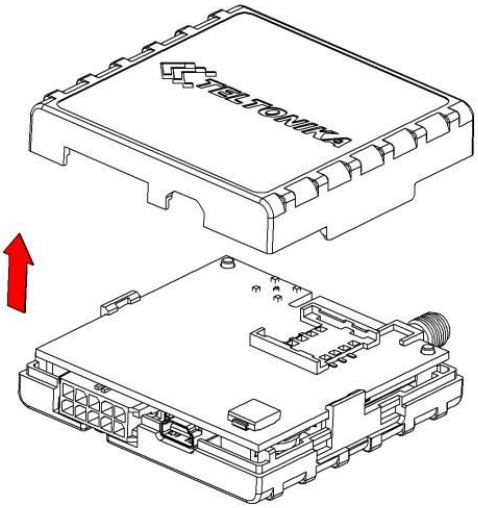
3 CONNECTION, PINOUT, ACCESSORIES

3.1 SIM card insert scheme



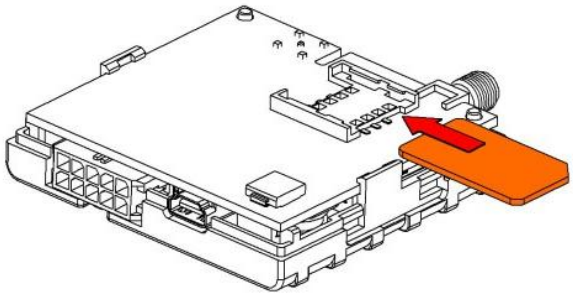
①

Gently open FM1100 case using screwdrivers



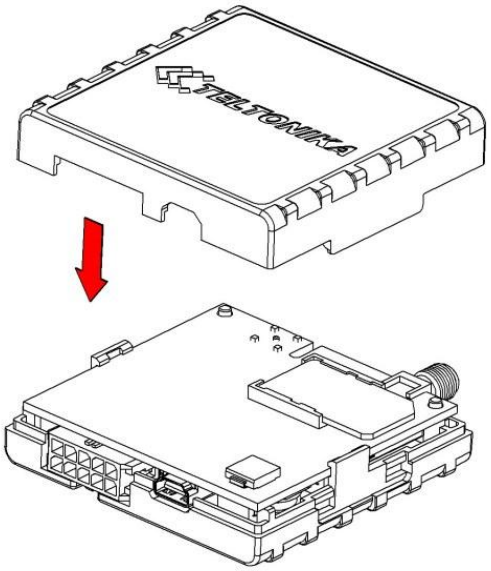
②

Take off FM1100 case



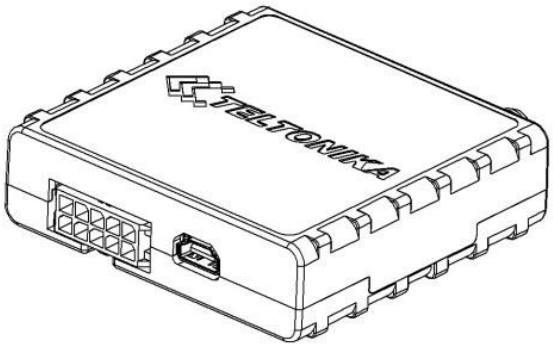
③

Insert SIM card as shown



④

Assemble devices top part



⑤

Device is ready

3.2 Installing FM1100 drivers

Software requirements

• Operating system 32-bit and 64-bit: Windows XP with SP3 or later, Windows Vista, Windows 7.

• MS .NET Framework V3.5 or later (http://www.microsoft.com or http://avl1.teltonika.lt/downloads/tavl/Framework/dotnetfx35setupSP1.zip).

Drivers

Please download Virtual COM Port drivers from Teltonika website: http://avl1.teltonika.lt/downloads/FM1100/vcpdriver_v1.3.1_setup.zip

Installing drivers

Extract and run VCPDriver_V1.3.1_Setup.exe. This driver is used to detect FM1100 device connected to the computer. Click 'Next' in driver installation window (figures below):

Figure 3. Driver installation window

This will launch device driver installation wizard. In the following window click 'Next' button again:

Figure 4. Driver installation window

Setup will continue installing drivers and will display a window about successful process in the end. Click 'Finish' to complete setup:

Figure 5. Driver installation window

You have now installed drivers for FM1100 device successfully.

3.3 Navigate LED

Behaviour	Meaning
Permanently switched on	GPS signal is not received
Blinking every second	Normal mode, GPS is working
Off	GPS is turned off because: • Deep sleep mode Or • GPS antenna short circuited

3.4 Status LED

Behaviour	Meaning
Blinking every second	Normal mode
Blinking every 2 seconds	Deep sleep mode
Blinking fast for a short time	Modem activity
Blinking fast constantly	Boot mode
Off	• Device is not working Or • Device firmware being flashed

3.5 Socket 2×5

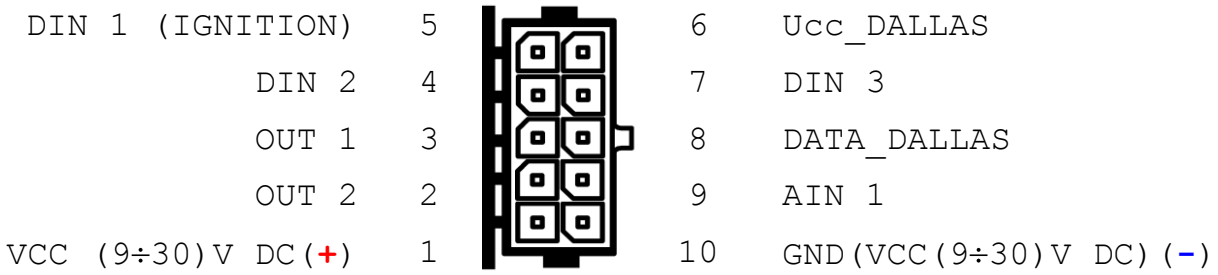


Figure 6. 2×5 socket pinout

Pin Nr.	Pin Name	Description
1	2	3
1	VCC (9÷30)V DC (+)	Power supply for module. Power supply range (9...30) V DC
2	OUT 2	Digital output. Channel 2. Open collector output. Max. ⎓ 300mA.
3	OUT 1	Digital output. Channel 1. Open collector output. Max. ⎓ 300mA.
4	DIN 2	Digital input, channel 2
5	DIN 1	Digital input, channel 1 DEDICATED FOR IGNITION INPUT
6	Ucc_DALLAS	+ 3,8 V output for Dallas 1-Wire® devices. (max 20mA)
7	DIN 3	Digital input, channel 3
8	DATA_DALLAS	Data channel for Dallas 1-Wire® devices
9	AIN 1	Analog input, channel 1. Input range: 0-30V/0-10V DC
10	GND(VCC(9÷30)V DC)(-)	Ground pin. (9÷30)V DC (—)

Table 2. Socket 2x5 pinout description.

3.6 USB

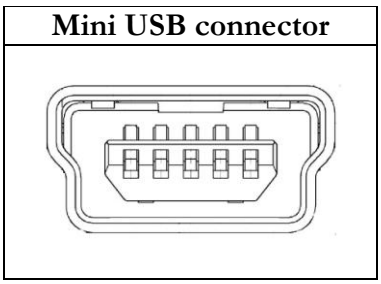


Figure 7. Mini USB type B connector

FM1100 when connected to PC creates STM Virtual COM Port, which can be used as system port (to flash firmware and configure the device).

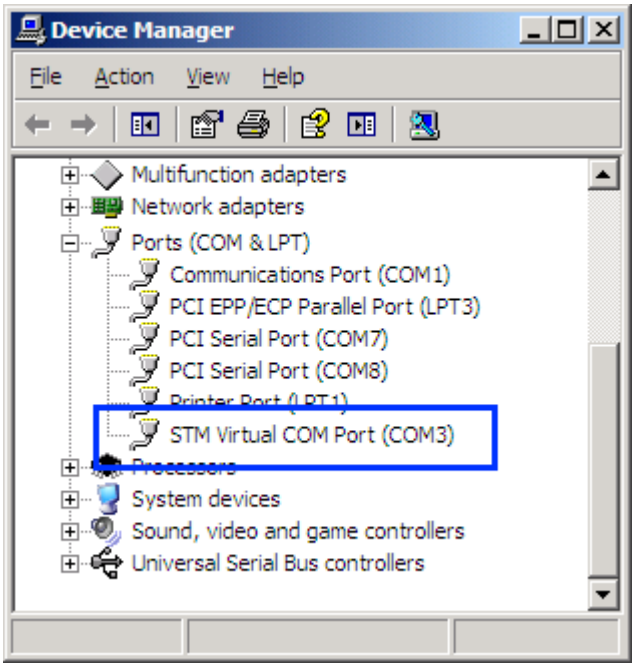


Figure 8. COM-Ports

3.7 Accessories

Note: Teltonika does not provide any additional equipment like panic buttons, door sensors or others.

Alarm buttons, door sensors, etc.

Alarm buttons, door sensors, ignition, etc. return two states: high or low voltage. Digital inputs are used to read this information. Figure below shows how to connect alarm button, door sensor, etc.

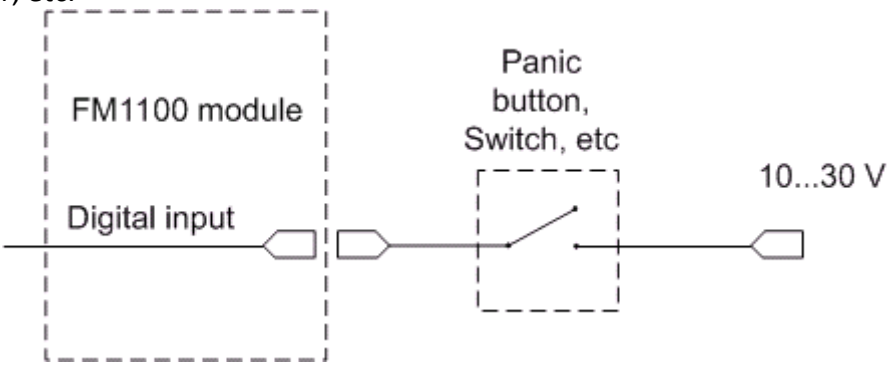


Figure 9. Panic button connection

In cases when sensor output signal is negative, an additional relay has to be installed to convert negative signal to positive.

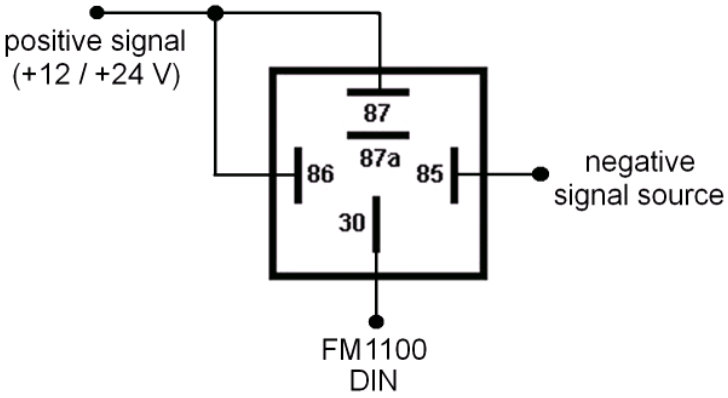


Figure 10. Inverting relay connection

Immobilizer relay

When connected as shown below, FM1100 disables engine starter when output is ON. More details about relays can be found below.

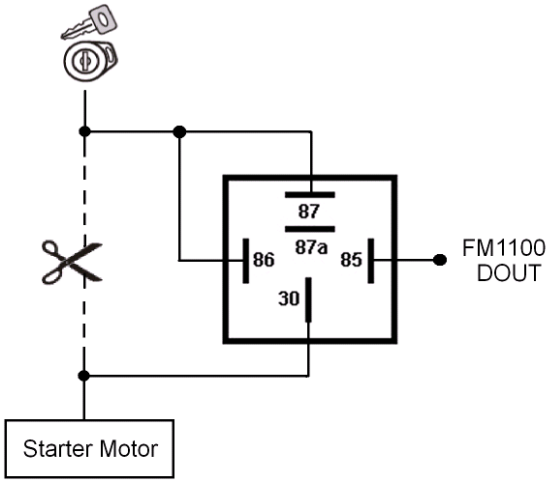


Figure 11. Immobilizer relay connection

Relays

A simple automotive relay is used to invert input signal or to immobilize engine starter. Note, that they are available as 12 V or 24 V.

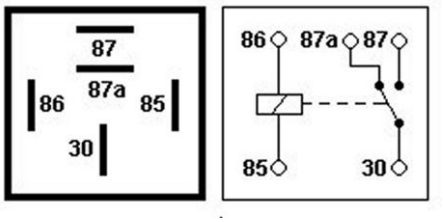


Figure 12. Automotive relay pinout

4 FIRMWARE

4.1 Updating firmware using USB cable

FM1100 functionality is always improving, new firmware versions are developed. Current module firmware version can be retrieved from configurator. See configuration description for details.

Contact sales manager to get the latest firmware.

Updater is needed to update the firmware. It can be downloaded from:
http://avl1.teltonika.lt/downloads/FM1100/

Firmware must to be copied to “Firmware updater” directory.

Connect FM1100 to PC with USB cable. Launch “Firmware Updater”, select COM port, click connect and update. Update process may take up to several minutes.

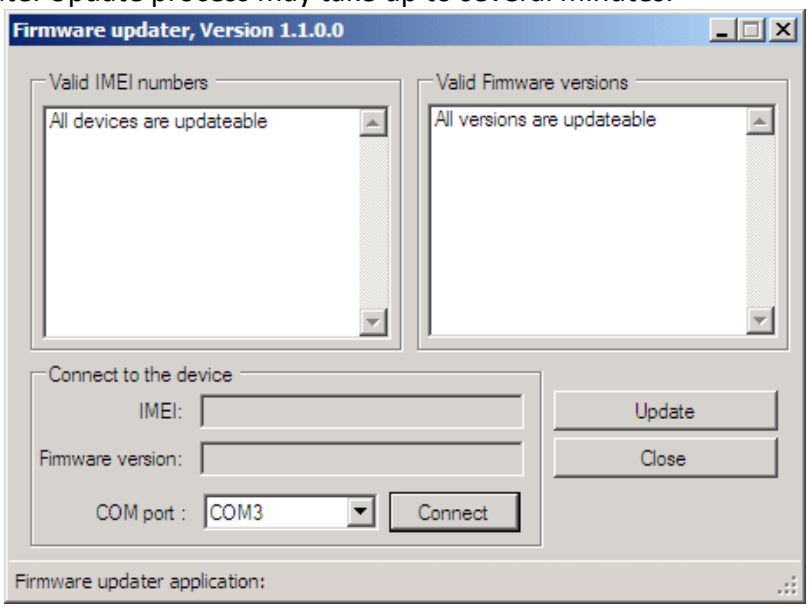


Figure 13. FM updater screen

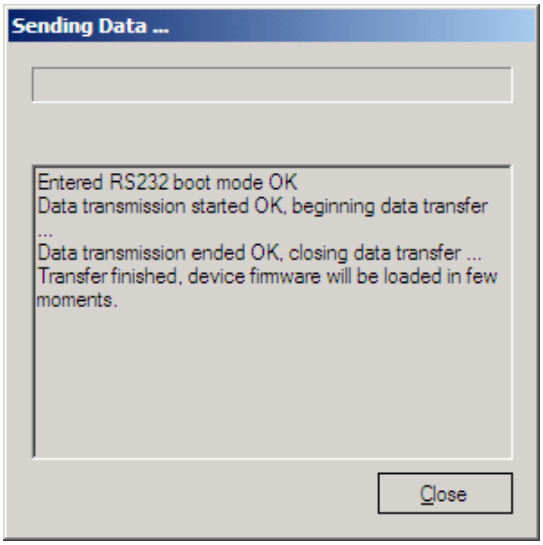


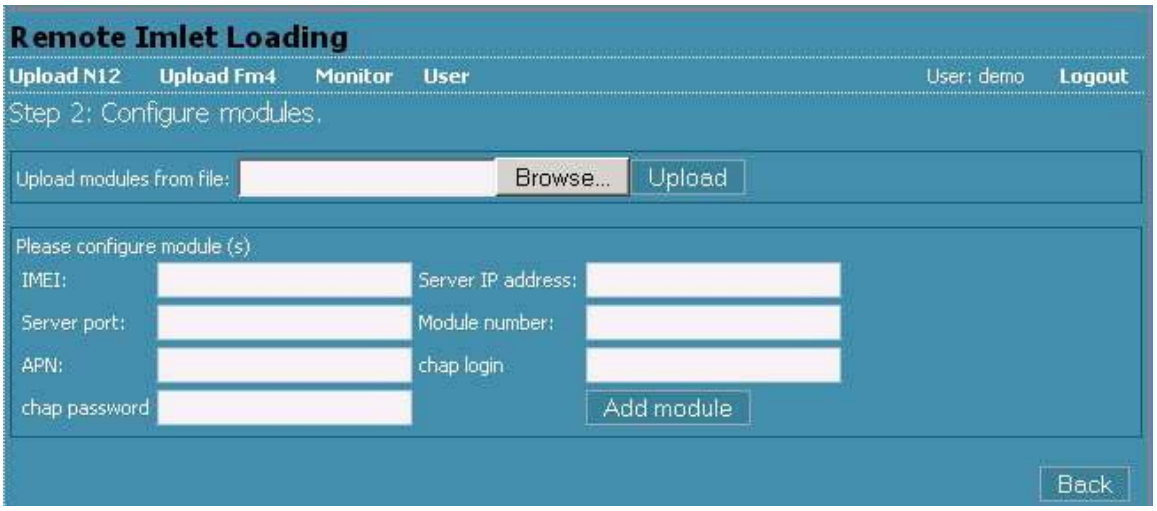
Figure 11. FM firmware updating finished

4.2 Updating firmware via GPRS

Firmware can also be updated over GPRS using RILS system.

RILS stands for Remote Imlet Loading System, which is used to update FM1100 processor firmware. In order to update firmware, server sends a SMS to the FM1100 and directs it to connect to the server and download new firmware. The special web interface is used for this operation. Address of the web application is: http://212.47.99.62:5002/RILS-web/.

For RILS login and password please contact your sales manager.



After logging in click on 'Upload FM4', click Browse, select FM1100 firmware file from hard disk, click OK and then Upload. Select uploaded firmware from the list (last one) and click next. Enter necessary parameters in the fields:

1. Server IP: 212.47.99.62
2. Server port: 5009
3. Module number is GSM number of FM SIM in worldwide standard, for example: +37069912345.

Enter your APN, APN (chap) login and password. After entering all parameters, click 'Add Module'. To operate multiple devices, enter new IMEI and GSM number and click 'Add Module' again. Otherwise click 'Next' and if all data is correct, in next window click 'Upload'.

5 OPERATIONAL BASICS

5.1 Operational principals

FM1100 module is designed to acquire records and send them to the server. Records contain GPS and I/O information. Module uses GPS receiver to acquire GPS data and is powered with three data acquire methods: time-based, distance-based and angle-based method. Method's details are described in 5.12 section. All data is stored in flash memory and later can be sent via GPRS or SMS channels. GPRS mode is most preferred data sending mode. SMS mode is mostly used in areas without GPRS coverage or GPRS usage is too expensive.

GPRS and SMS settings are described in later sections. FM1100 communicates with server using special data protocol. Data protocol is described in "FMXXXX Protocols" document.

FM1100 can be managed by SMS commands. SMS Command list is described in SMS COMMAND LIST section. Module configuration can be performed over TCP or via SMS. Configuration parameters and modes are described in "FMXXXX Protocols" document.

5.2 Deep Sleep mode

While in deep sleep mode, FM1100 sets GPS receiver to sleep mode and turns off GSM/GPRS module (it is not possible to wake up device via SMS), therefore records with last good coordinates are being saved and send to AVL server if configured (GSM/GPRS module is turned on to send data and after turned off). Depending on two configurable parameters, send period and min period, in Deep Sleep mode power usage can be decreased dramatically to save vehicle's battery.

FM1100 can enter deep sleep mode (standby mode) if **ALL** of these conditions are met:

- FM1100 has to be configured to work in Deep Sleep mode;
- Startup timeout has elapsed (5 minutes after every restart of the device);
- No movement by movement sensor is detected;
- Ignition (DIN1) is off (driven logic low);
- Send period in stop mode is more than 60 seconds (Data Acquisition Mode settings);
- USB cable is not connected.

FM1100 exits deep sleep mode when if **ONE** of following conditions are true:

- Movement by movement sensor is detected;
- Ignition (DIN1) is turned on (driven logic high);
- USB cable is connected;

5.3 Virtual odometer

Virtual odometer is used to calculate traveled distance in FM1100 as a separate I/O element. When FM1100 detects movement, it starts counting distance using GPS signal: every second it checks current location and calculates distance between current and previous point. It keeps adding these intervals until it is time to make a record, then FM1100 records its location and adds odometer value, which is equal to the sum of all distances, measured every second. When record is made, odometer resets to zero and distance calculation starts all over again.

Virtual odometer as an I/O element can be also used with Trip feature, read 5.4.2 and 5.13.2 chapters.

5.4 Features

Using available features can greatly increase FM1100 usability options.

5.4.1 Scenarios

Four scenarios are available on FM11 device.
Digital Output No.1 is used by scenarios - Green Driving **or** Over Speeding;
Digital Output No.2 is used by scenarios - Authorized Driving **or** Immobilizer.

Green Driving Scenario. Helps to prevent and inspect driver about harsh driving. Scenario continuously monitors: accelerating force, braking force and cornering angles. Inspects driver if needed. DOUT1 is controlled by scenario for user needs, for example buzzer or LED.

To save GPRS traffic Green Driving event will be **generated (included into send records) only** when FM1100 measured values are higher than those set in configuration, without additional I/O settings.

Note: Green Driving Scenario is in on various cars and various drivers testing phase and can be subject to changes. Teltonika is constantly working on improvement of the functionality of the devices, and strongly recommends using the latest version of the firmware.

Over Speeding Scenario. Helps to prevent from exceeding fixed speed and inspects driver if needed. DOUT1 is controlled by scenario for user needs, to manage buzzer, LED etc.

Authorized Driving Scenario. Gives ability to use vehicle only for 50 specific iButton owners (specified in iButton list). DOUT2 is controlled by scenario for user needs, to manage buzzer, LED etc.

Immobilizer Scenario. Vehicle can be used only if iButton is connected. In this scenario iButton list is not used; connect any iButton to pass Immobilizer security. DOUT2 is controlled by scenario for user needs.

5.4.2 Trip

Trip customizable feature enables user extended monitoring of performed trips (from engine start at present location to engine stop at arrived location), log their start and stop points, view driven total distance. Event will be **generated (included into send records) only** when trip starts and finish.

5.4.3 Geofencing

Geofencing is another feature which is highly customizable and can detect wherever car enters or leaves customized areas. More about Geofencing can be read in 5.13.3 chapter.

Auto Geofencing feature if enabled is activated automatically by turning off car ignition. Next time before driving user has to disable Auto Geofencing with iButton or by turning on car ignition. In case of theft car leaves Auto Geofencing zone without authorization FM1100 device automatically sends high priority record to AVL application.

5.4.4 iButton list

iButton list is used to enter authorized iButton ID codes, which are used to authenticate driver in Authorized driving and Auto Geofencing options.

5.5 CONFIGURATION

5.6 Configurator

New FM1100 module has default factory settings. Settings should be changed according to your application and your GSM operator information.

FM1100 configuration is performed via FM1100 Configurator program. FM1100 Configurator version can be downloaded from http://avl1.teltonika.lt/downloads/FM1100/. Contact sales manager to get the latest FM1100 Configurator version. FM1100 configurator operates on Microsoft Windows OS and uses MS .Net Framework 3.5 or higher. Please ensure that MS .Net Framework 3.5 or later is installed on your PC before starting configurator. Latest MS .Net Framework version can be downloaded from official Microsoft web page.

Module configuration is performed over USB cable. Configuration process starts from starting FM1100 Configurator program and then connecting to FM1100 device via Connect button located on the top left corner of configurator. If connected successfully IMEI, Version fields which were empty, now are filled with certain numbers depending on Modem IMEI and firmware version of your device (figure below).

FM1100 has one user editable profile, which can be loaded from device, and saved. User can also revert to default settings, by pressing Load Defaults button. After any modification of configuration settings it has to be saved to FM1100 device, otherwise it will not be written to device.

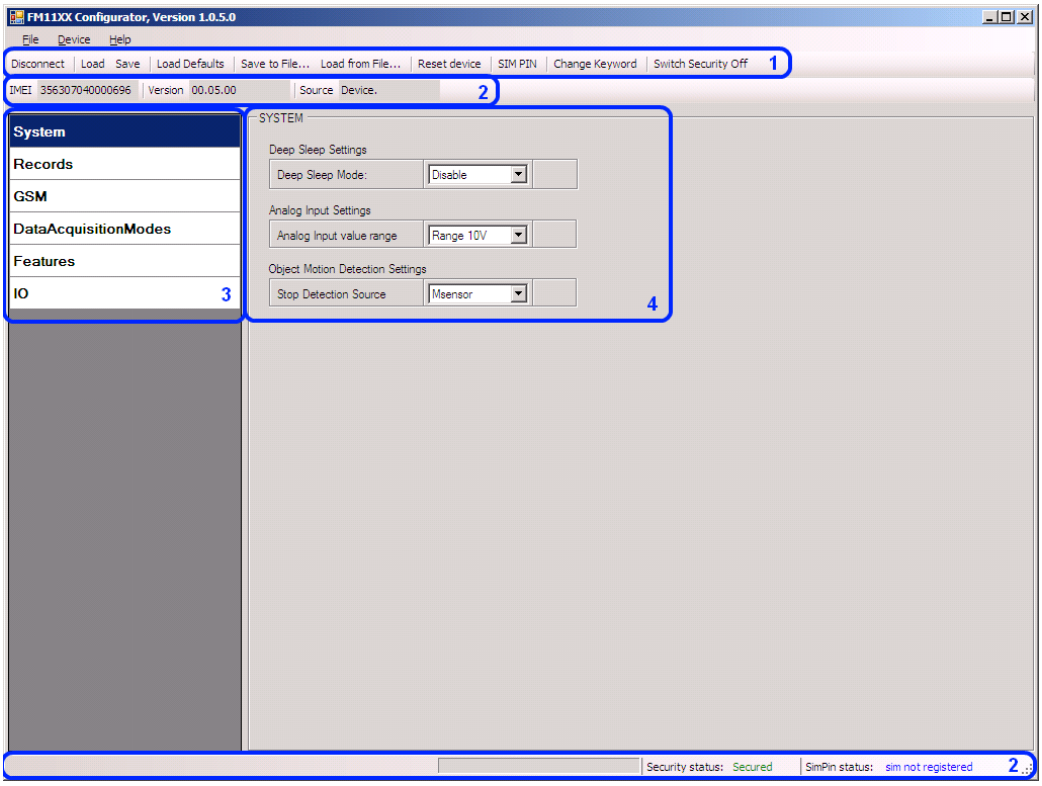


Figure 14. Configurator window

FM1100 Configurator is divided into 4 main areas: 1 – main button area, 2 – information area, 3 –settings menu, 4 – parameters and values menu.

Button description:

'Connect' – connects device

'Load' – reads configuration parameters from FM1100 Flash memory.

'Save' – saves configuration parameters to FM1100 Flash memory.

'Load Defaults' – loads default FM1100 settings that later can be modified. This procedure must be performed before entering new parameters.

'Save to File…' – allows user to save currently entered settings to .XML file, for later usage.

'Load from File…' – allows user to load configuration saved in .XML extension file.

'Reset device' – reboots FM1100 and displays processor firmware version.

Additional buttons:

'SIM PIN' – this button is used to enter PIN code if inserted SIM card has activated PIN code security.

'Add Keyword' / 'Change Keyword' / 'Switch Security Off' – buttons are used to protect configurator from unauthorized access to configuration.

Keyword is 4 -10 symbol length. If keyword is set, every time user reconnects FM2200 to USB port, user will be asked to provide valid keyword when connecting FM1100 to configurator. User is given 5 attempts to enter valid keyword. After entering valid keyword, counter resets to 5.

If user disconnects FM2200 using 'Disconnect' button and does not disconnect from USB port, after reconnecting using 'Connect' button, configurator does not ask for keyword.

5.7 System settings

System settings have 3 configurable parameters:

Deep sleep settings, where user can turn deep sleep on or off.

Analog Input Settings, where user can choose analog input range 10 V or 30 V, depending on needed accuracy, and input voltage.

Object Motion Detection Settings, where user can configure 3 ways how FM1100 will detect stopped movement, and change its working mode (for working modes, read section 5.12).

Stop Detection Source	Vehicle on Stop mode	Vehicle Moving mode
Ignition	ignition (DIN1) is logic low	if ignition (DIN1) is logic high
Msensor (movement sensor)	internal movement sensor does not detect movement	internal movement sensor detects movement
GPS	GPS fix is available and vehicle speed is lower than 5 km/h	GPS fix is available and vehicle speed is higher than 5 km/h
	while GPS fix is unavailable, Object Motion Detection Settings is working like previously mentioned Msensor mode	

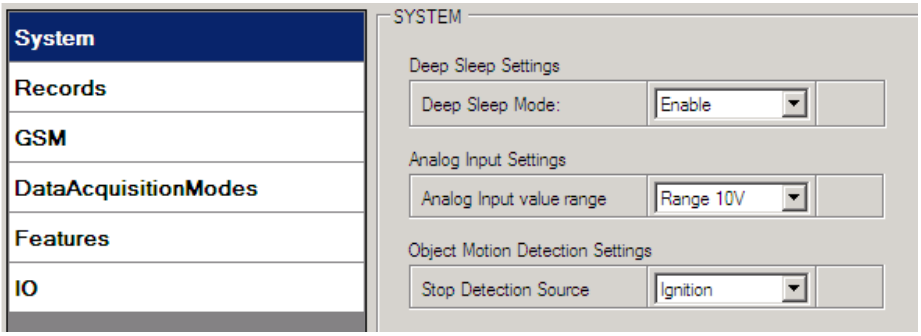


Figure 15. System settings configuration

5.8 Records settings

Here user can modify if FM1100 device will send newest records first, meaning, that the most important thing is to know recent position of car, older records are being sent right after newest records arrive to AVL application.

Activate Data Link Timeout is used to set timeout of link between FM1100 and AVL application termination. If FM1100 already sent all records it waits for new records before closing link. If new records are generated in the period of this timeout, and minimum count to send is reached, they are send to AVL application. This option is useful in conditions where GSM operators put charge on every link activation.

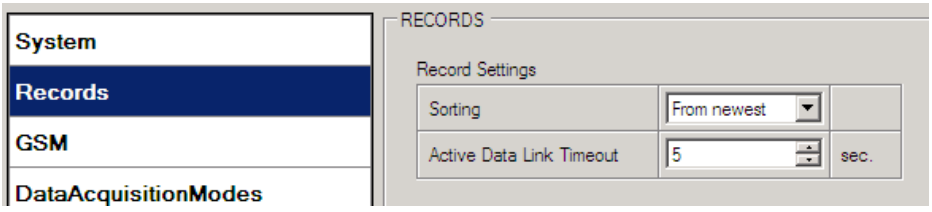


Figure 16. Records settings configuration

5.9 GSM settings, GPRS part

'GPRS' define main parameters for FM1100: GSM operator APN and GPRS username and password (optional – depending on operator), destination server IP and port, and allows to set protocol used for data transfers – TCP or UDP

Some operators use specific authentification for GPRS session – CHAP or PAP. If any of these is used, APN should be entered as '`<APN>:c`' or '`<APN>:p`'. I.e. if operator is using APN 'internet' with CHAP authentification, it should be entered as '`internet:c`'. Information about APN and authentification type should be provided by your GSM operator.

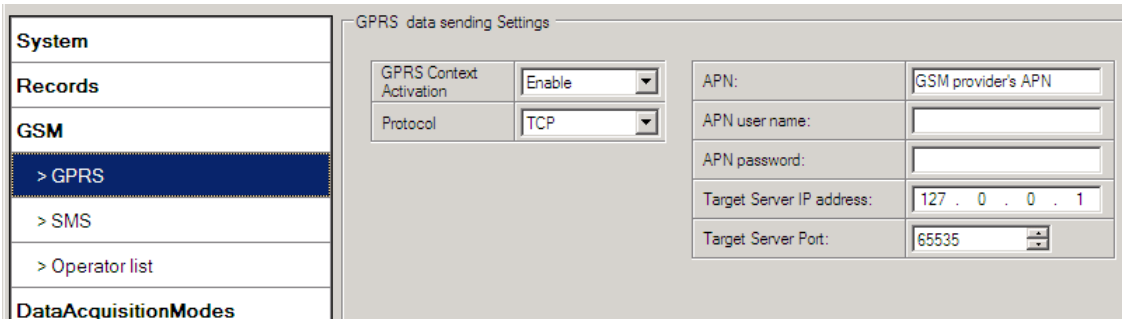


Figure 17. GPRS configuration

5.10 GSM settings, SMS part

Essential fields in 'SMS' part is 'Login' and 'Password'. This login and password is used with every SMS sent to FM1100. If login and password is not set, in every SMS send to FM1100 device two spaces before command has to be used (<space><space><command>).

Command structure with set login and password:

<login><space><password><space><command>, example: "asd 123 getgps"

Phone numbers has to be written in international standard, without using "+" or "00" signs in prefix. If none numbers are entered, configuration and sending commands over SMS are allowed from all GSM numbers.

SMS data sending settings – enable or disable **periodic** data and event SMS usage. Note, that this does not affect replies to messages – they are always sent to sender number.

FM1100 can send SMS with 24-coordinates-in-one-SMS, it is used in areas where no GPRS coverage is available. Module collects data and sends to server binary SMS containing information about last 24 collected points. SMS sending schedule is set in SMS Week Time tab. 24-Coordinates SMS decoding is described in "FMXXXX Protocols" document.

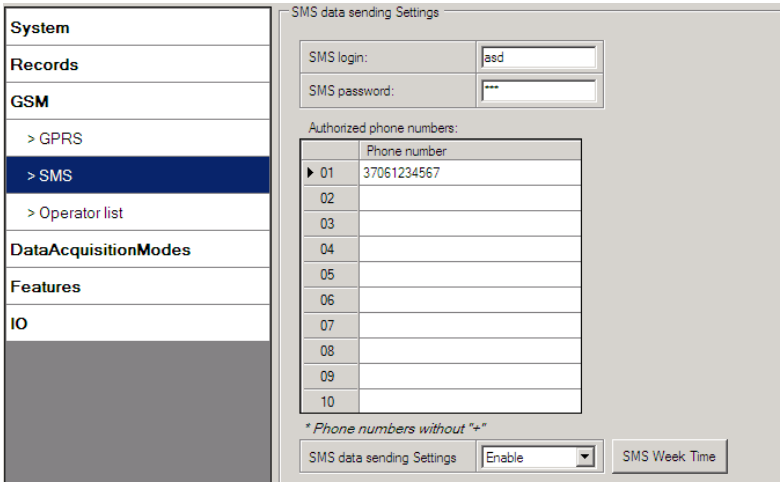


Figure 18. SMS configuration

SMS login and password and authorized number list are used to protect FM1100 module from unauthorized access. Module accepts messages only from a list of authorized numbers and with proper module login and password. Numbers must be without "+" or "00" prefix. If no authorized numbers are entered, module accepts messages from all numbers.

5.11 GSM settings, Operator list

Operators list – FM1100 is able to use GPRS with all operators, but if at least one operator is entered in the list, FM1100 is allowed to connect to GPRS only while operating in listed operator's network.

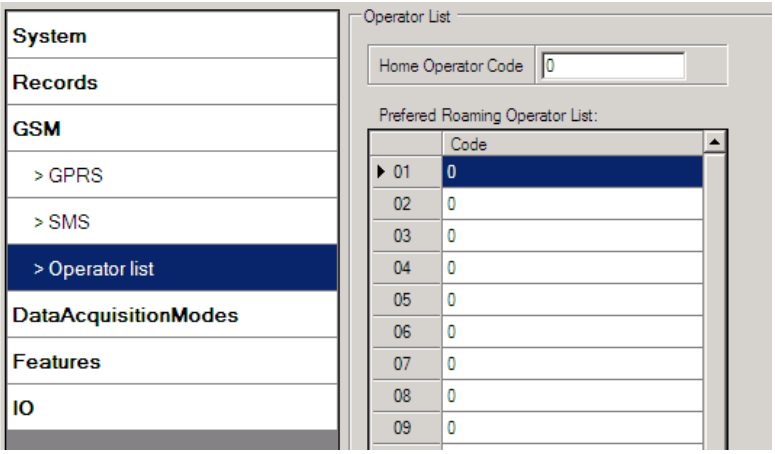


Figure 19. Operator list configuration

5.12 Data Acquisition Mode settings

Data Acquisition Modes are essential part of FM1100 device, it is also highly configurable.

By configuration user defines how records will be saved and sent. There are three different modes: Home, Roaming and Unknown. All these modes with configured data acquisition and send frequencies depend on current GSM Operator defined in Operator list (see section 5.11) and are being switched when GSM operator changes (e.g. vehicle passes through country boarder).

If current GSM operator is defined as Home Operator, device will work in Home Data Acquisition mode, if current operator is defined as Roaming Operator, device will work in Roaming Data Acquisition mode, and if current operator code is not written in Operator list (but there is at least one operator code in the operator list), device will work in Unknown Acquisition mode.

This functionality allows having different AVL records acquire and send parameters values when object is moving or stands still. Vehicle moving or stop state is defined by Stop Detection Source parameter. There are 3 ways for FM1100 to switch between Vehicle on Stop and Vehicle Moving modes see section 5.7.

As result, FM1100 allows to have 6 different modes. Operational logic is shown Figure 20.

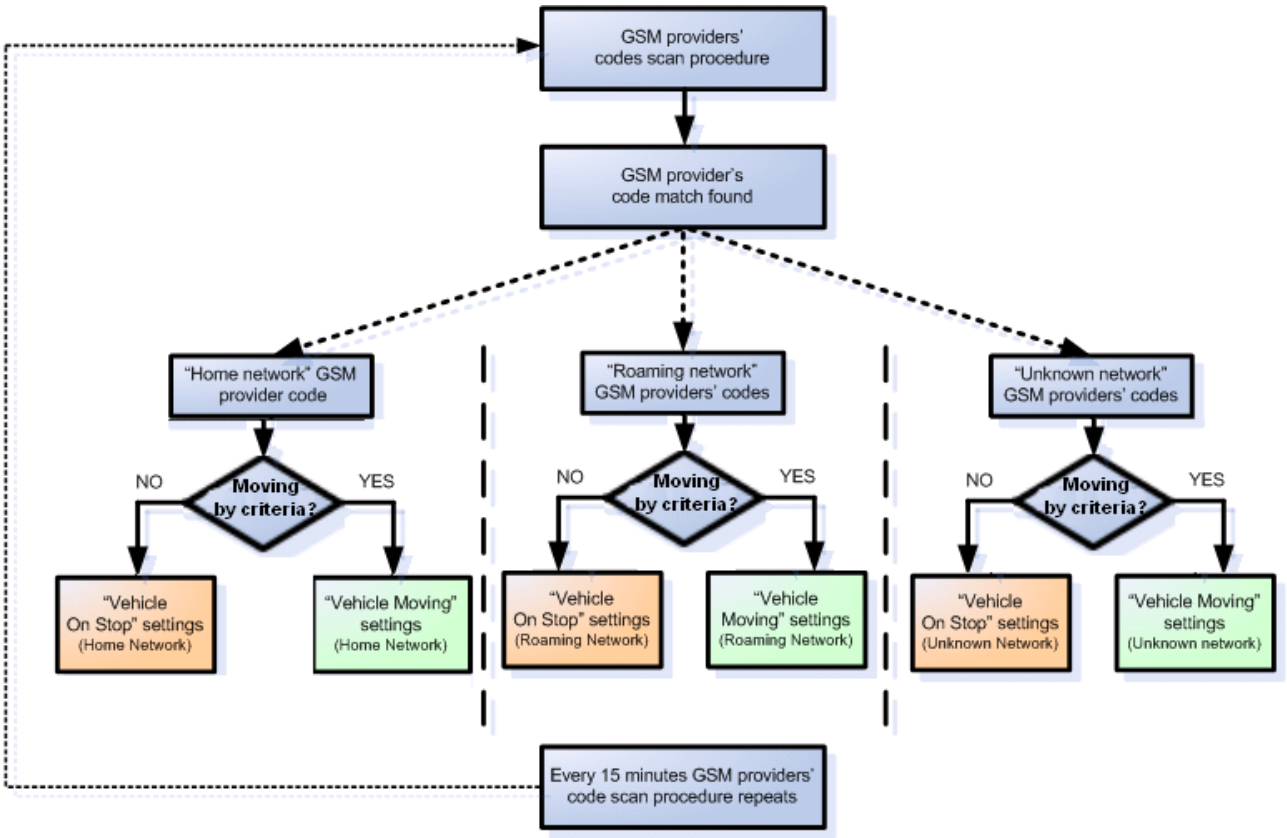


Figure 20. Data Acquisition Mode configuration

Operator search is performed every 15 minutes; this does not mean that Home, Roaming and Unknown modes can be changed only then. This is separate process and depends on current GSM operator. Movement criteria are checked every second.

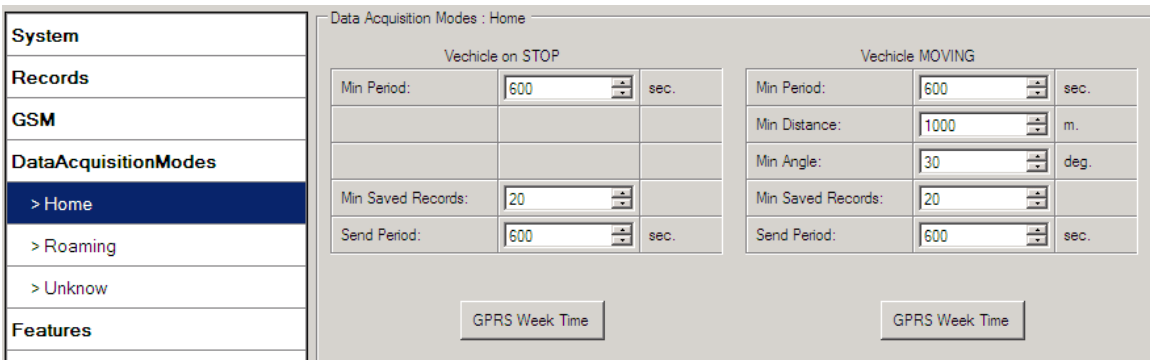


Figure 21. Data Acquisition Mode configuration

'Min Saved Records' defines minimum number of coordinates and I/O data that should be transferred with one connection to server. If FM1100 does not have enough coordinates to send to server, it will check again after time interval defined in 'Sending Period'

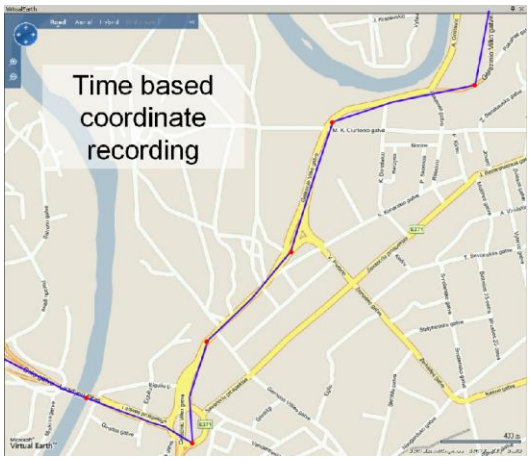
Send period – GPRS data sending to server period. Module makes attempts to send collected data to server every defined period. If it does not have enough records (depends on parameter Min. Saved Records described above), it tries again after defined time interval.

GPRS Week Time tab – most GSM billing systems charge number of bytes (kilobytes) transmitted per session. During the session, FM1100 makes connection and transmits data to a server. FM1100 tries to handle session as much as possible; it never closes session by itself. Session can last hours, days, weeks or session can be closed after every connection in certain GSM networks – this depends on GSM network provider. GPRS Context Week Time defines session re-establish schedule if session was closed by network. New GPRS context is opened if time is 10 minutes till time checked in table. Therefore if all boxes are checked, FM1100 is able to open new connection anytime. At scheduled time match FM1100 checks for GPRS session activity. If GPRS session is alive, FM1100 sends data to server according to Send period parameter. If it is not, FM1100 checks if it is able to re-establish the session.

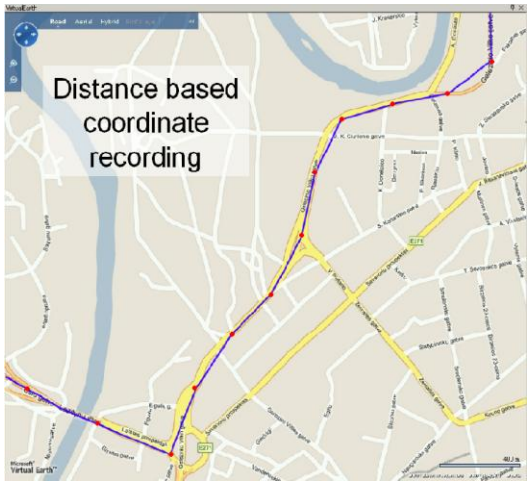
Device is checking if the time between last saved record and current time is equal or higher than Time based acquire interval. If so, FM saves record to memory. If not, FM checks if the distance from last record to current record is equal or higher than Distance based acquire interval. If so, saves the record to memory. If not and speed is higher than 10km/h, then FM is checking if angle difference between last record and current record is equal or higher than Angle based acquire value. If so, saves the record to memory. This check is being performed every second.

FM1100 is able to collect records using three methods at the same time: time, distance and angle based data acquisition:

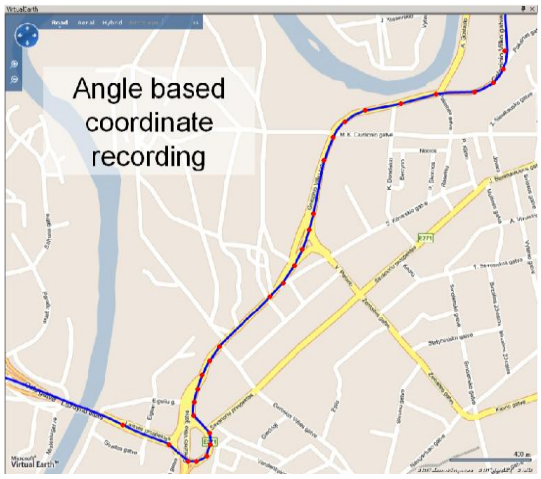
Time based data acquiring (Min. period) – records are being acquired every time when defined interval of time passes. Entering zero disables data acquisition depending on time.



Distance based data acquiring (Min. distance) – records are being acquired when the distance between previous coordinate and current position is greater than defined parameter value.
Entering zero disables data acquisition depending on distance.



Angle based data acquiring (Min. angle) – records are being acquired when angle difference between last recorded coordinate and current position is greater than defined value. Entering zero disables data acquisition depending on angle.



5.13 Features settings

For more information about available Scenarios, Trip, Geofencing and iButton list, refer to 5.4 chapter.

5.13.1 Scenarios settings

In Scenarios window four different scenarios are available, two per each Digital Output (DOUT). Only one per digital output can be active at a same time, e.g. DOUT1 can have either Green driving or Over Speeding enabled, DOUT2 can have either Authorized Driving or Immobilizer enabled.

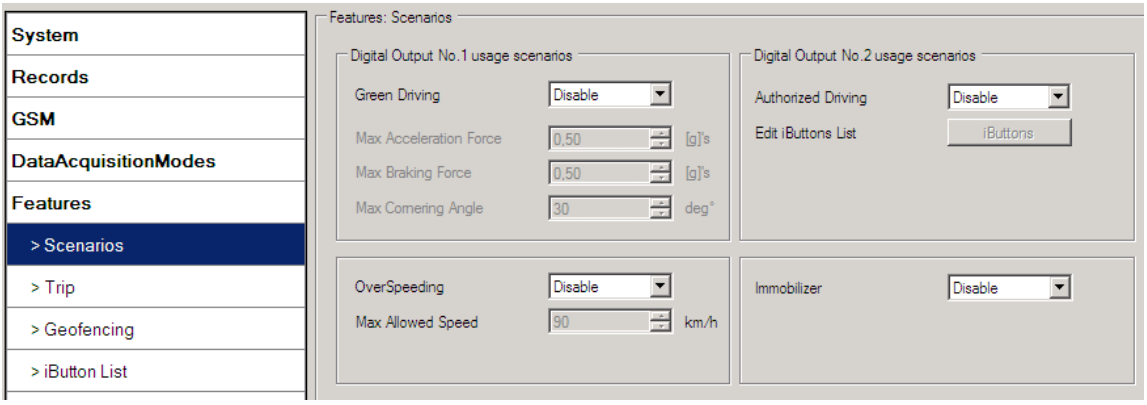


Figure 22. Scenarios configuration

Digital Output (open drain grade) usage in scenarios:

- Green Driving
  DOUT1 is ON for:
  - 3sec. if detected value is over (0; 30] % from preconfigured allowed value
  - 5sec. if detected value is over (30; 50] % from preconfigured allowed value
  - 7sec. if detected value is over (50; -] % from preconfigured allowed value

  After period of time DOUT1 is turned OFF.

- Over Speeding
  DOUT1 is ON and blinking with 300 ms duty cycle. While vehicle speed exceeds parameter value DOUT1 is activated until current speed is not decreased below parameter value.

- Authorized driving
  DOUT2 is ON continuously. After authorizing iButton, DOUT2 turns off. After successful authorization DIN1 (ignition) can be turned OFF for no longer than 30 seconds, otherwise authorization must be repeated.

- Immobilizer
  DOUT2 is ON continuously, after 1 minute blinks with 300 ms duty cycle if iButton is not connected. DOUT2 turns OFF, after iButton is connected. After successful deactivation of immobilizer DIN1 (ignition) can be turned OFF for no longer than 30 seconds, otherwise Immobilizer security will be turned on and deactivation must be repeated.

5.13.2 Trip settings

Trip window offers user to configure Trip feature. If Trip is enabled configuration of parameters are enabled.

Start Speed – speed, which is detected as minimum speed to indicate Trip start.

Ignition Off Timeout – timeout to wait if ignition was off, to detect Trip stop.

Continuous distance counting – Not or Continuous can be chosen. For this feature I/O Odometer must be enabled (see Figure 24)

If I/O Odometer is enabled and Continuous distance counting variable is set to Continuous, Trip distance is going to be counted continuously (from Trip start to Trip stop). This value is written to I/O Odometer value field. When Trip is over and next Trip begins, Odometer value is reset to zero, and is counted continuously again.

If I/O Odometer is enabled and Continuous Distance Counting variable is set to Not, then distance is going to be counted only between every record made. This value is written to I/O Odometer value field and reset to zero every new record until Trip stops. If later all Odometer values are summed up manually user gets distance driven over whole Trip period.

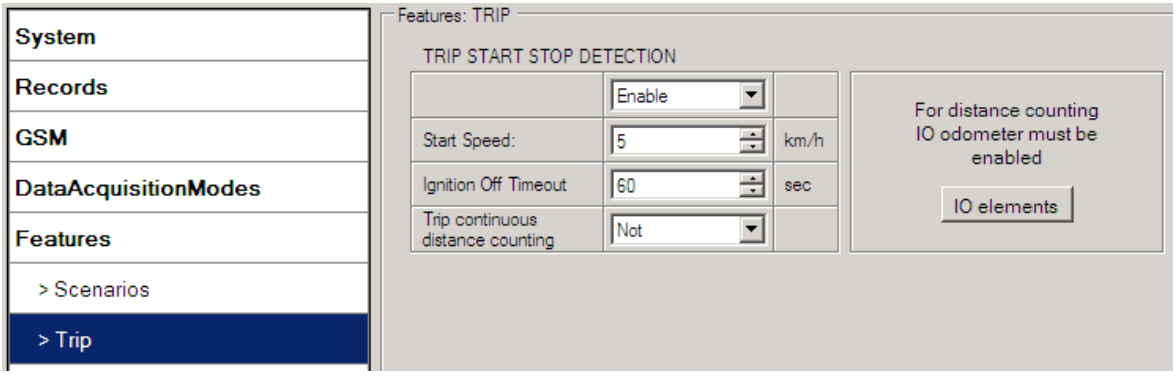


Figure 23. Trip configuration

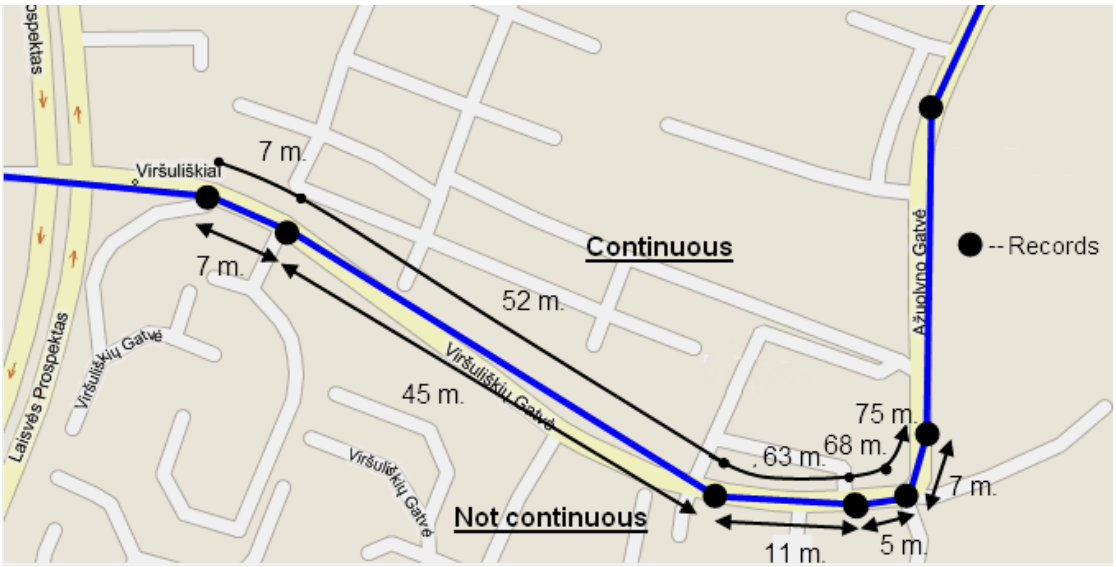


Figure 24. Trip continuous distance counting parameter example

5.13.3 Geofence settings

FM1100 has 5 configurable Geofence zones and it can generate event when defined Geofence zone border is crossed.

Frame border – frame border is an additional border around Geofence zone. It is additional area around defined zone used to prevent false event recording when object stops on the border of the area and because of GPS errors some records are made inside area and some – outside. Event is generated only when both borders are crossed. See figure for details: track 1 is considered to enter the area while track 2 does not.

Figure 25. Geofence border

Shape – can be rectangular or circle

Priority – priority of Geofence event: low, high or panic. These levels define priority of event information sending to server. See I/O element description for more details about priorities.

Generate event (On entrance, On exit, On Both) – choose when record will be generated;

X1 – geofence zone left bottom corner X coordinate;

Y1 – geofence zone left bottom corner Y coordinate;

X2 or R – geofence zone upper right corner X coordinate (radius of circle when Circular zone used);

Y2 – geofence zone upper right corner Y coordinate;

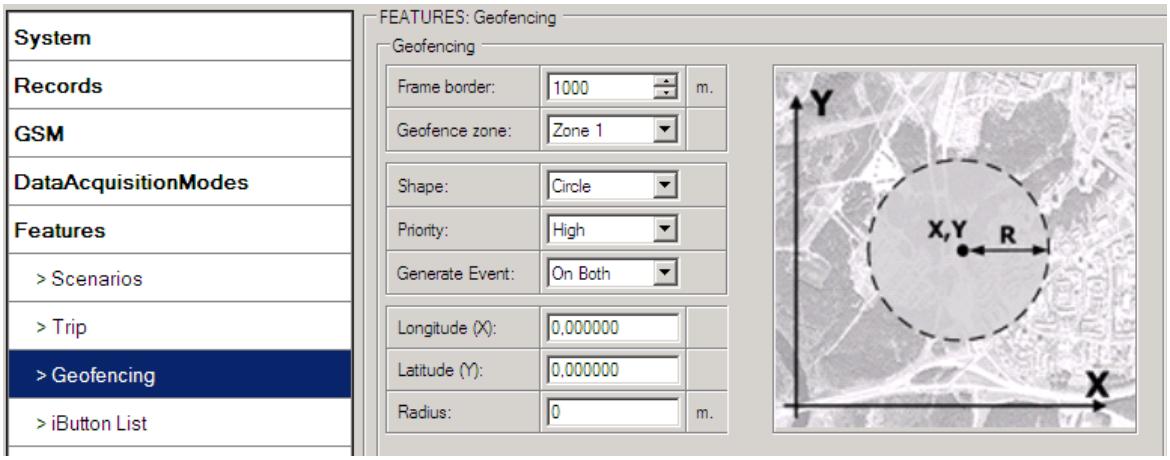


Figure 26. Geofence configuration

Auto Geofencing option can be configured by following parameters visible in figure below. Note, that Auto Geofencing does not require entering coordinates, instead it requires GPS visibility. If vehicle ignition was turned off and activation timeout is passed, Auto Geofence will be created around vehicle last position by set Radius value. If there is no GPS signal available Auto Geofencing will not work.

Auto Geofence event generation works the same as Geofencing mentioned above.

Auto Geofence protection can be switched off by two ways: ignition or authorized iButton.

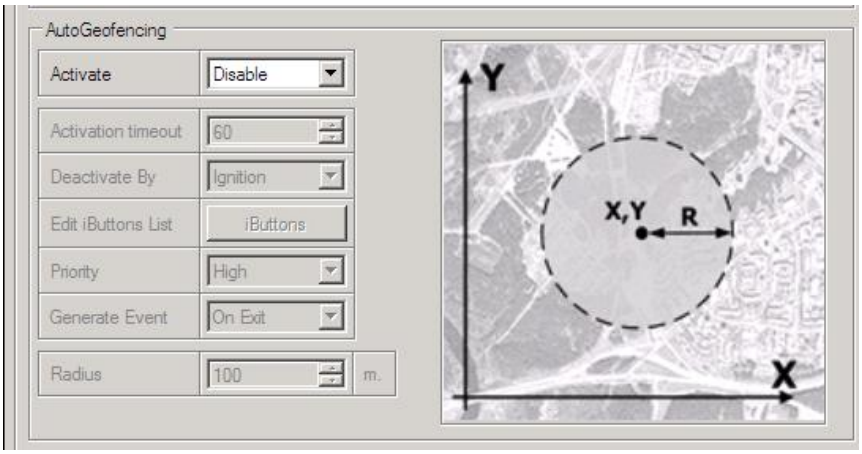


Figure 27. Geofence configuration

Note FM1100 operates GMT time without daylight saving.

5.14 I/O settings

When no I/O element is enabled, AVL packet comes with GPS information only. After enabling I/O element(s) AVL packet in couple with GPS information contains current value(s) of enabled I/O element.

Property ID	Property Name	Bytes	Description
1	Digital Input Status 1	1	Logic: 0 / 1
2	Digital Input Status 2	1	Logic: 0 / 1
3	Digital Input Status 3	1	Logic: 0 / 1
9	Analog Input 1	2	Voltage: mV, 0 – 30 V
21	GSM signal level	1	Value in scale 1 – 5
24	Speedometer	2	Value in km/h, 0 – xxx km/h
66	External Power Voltage	2	Voltage: mV, 0 – 30 V
72	Dallas Temperature	4	10 * Degrees (°C), -55 - +115, if 3000 – Dallas error

78	iButton Input	8	iButton ID number
80	Working mode	1	0 – home on stop, 1 – home on move, 2 – roaming on stop, 3 – roaming on move, 4 – unknown on stop, 5 – unknown on move
155	Geofence zone 01	1	Event: 0 – target left zone, 1 – target entered zone
156	Geofence zone 02	1	Event: 0 – target left zone, 1 – target entered zone
157	Geofence zone 03	1	Event: 0 – target left zone, 1 – target entered zone
158	Geofence zone 04	1	Event: 0 – target left zone, 1 – target entered zone
159	Geofence zone 05	1	Event: 0 – target left zone, 1 – target entered zone
175	Auto Geofence	1	Event: 0 – target left zone, 1 – target entered zone
179	Digital output 1 state	1	Logic: 0 / 1
180	Digital output 2 state	1	Logic: 0 / 1
181	PDOP	2	Probability * 10; 0-500
182	HDOP	2	Probability * 10; 0-500
199	Virtual Odometer	4	Distance between two records: m
200	Deep Sleep	1	0 – not deep sleep mode, 1 – deep sleep mode
205	Cell ID	2	GSM base station ID
206	Area Code	2	Location Area code (LAC), it depends on GSM operator. It provides unique number which assigned to a set of base GSM stations. Max value: 65536
240	Movement	1	0 – not moving, 1 – moving.
241	Current Operator Code	4	Currently used GSM Operator code
250	Trip	1	1 – trip start, 0 – trip stop
251	Immobilizer	1	1 – iButton connected
252	Authorized driving	1	1 – authorized iButton connected
253	Green driving type	1	1 – harsh acceleration, 2 – harsh braking, 3 - harsh cornering
254	Green driving value	2	Depending on green driving type: if harsh acceleration or braking – g*100 m/s^2, if harsh cornering – degrees
255	Over Speeding	2	At over speeding start km/h, at over speeding end km/h

There are two types of operations with I/O elements: simple monitoring and event generating. Monitoring method is used when current I/O information needed with regular GPS coordinates. Event generating method is used when additional AVL packet is needed when current value of I/O exceeds predefined High and Low levels. I/O settings allow defining I/O event criteria.

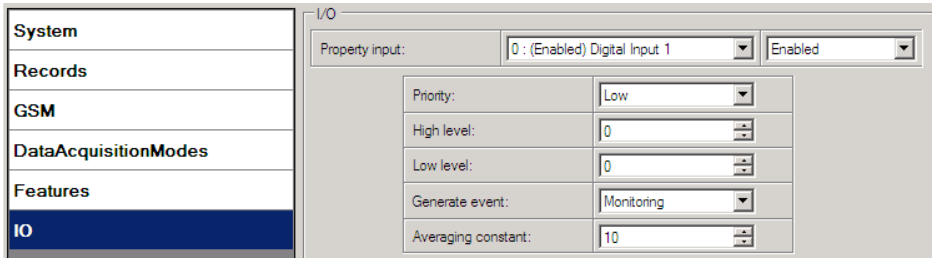


Figure 28. I/O settings

Enabled or disabled field – allows enabling I/O element so it is added to the data packet and is sent to the server. By default all I/O element are disabled and FM1100 records only GPS coordinates.

Priority – AVL packet priority – low, high or panic. Regular packets are sent as Low priority records. When low priority event is triggered, FM1100 makes additional record with indication that the reason for that was I/O element change. When High priority is selected, module makes additional record with high priority flag and sends event packet immediately to the server by GPRS. Panic priority triggers same actions as high priority, but if GPRS fails, it sends AVL packet using SMS mode if SMS is enabled in SMS settings.

High and Low levels – define I/O value range. If I/O value enters or exits this range, FM1100 generates event. "Generate event" parameter defines when to generate event – when value enters defined range, exits it or both.

Averaging constant – it is an I/O event delay parameter. In some applications there is no need to generate events on every I/O range enter/exit immediately. Sometimes it is necessary to wait some time interval before event generating. Averaging constant allows setting I/O event delay (averaging). If I/O value is entering or leaving predefined range, it must have same value for Averaging constant time. 1 Averaging constant value equals 1 second. There is no Averaging on DIN1, and in Deep Sleep mode.

5.14.1 Monitoring

I/O monitoring starts after enabling I/O element and setting up I/O parameters as it is shown below:

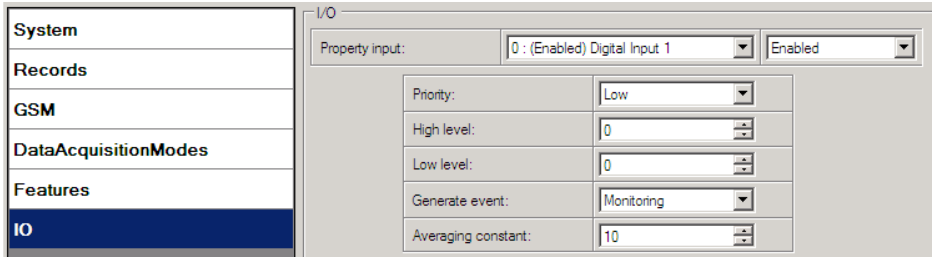


Figure 29. I/O settings

5.14.2 Event Generating

Events happen when the value of enabled I/O intersects thresholds (enter, exit or on both) predefined by High and Low level thresholds. Table below defines all available values of I/O settings.

Priority	low, high
High level	maximum threshold
Low level	minimum threshold
Generate event	on interval enter, on interval exit, on both enter and exit
Average constant	$1 – 2^{32}$ (4 Bytes)

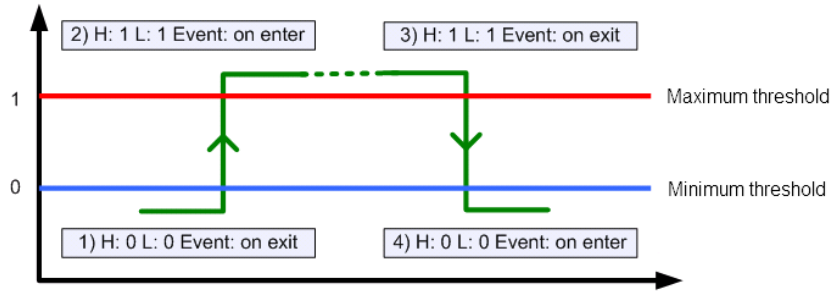
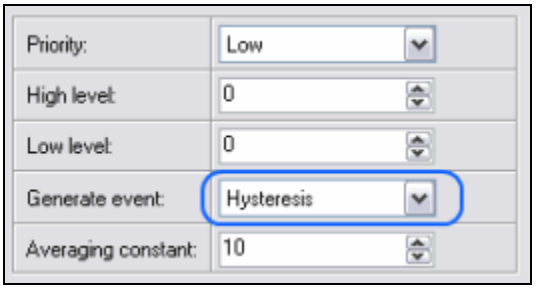


Figure 30. Digital Input event generation example

5.14.3 Hysteresis



I/O elements can generate events according to hysteresis algorithm. If I/O event operand "Hysteresis" is selected, events will be generated as it is shown in the illustration below:

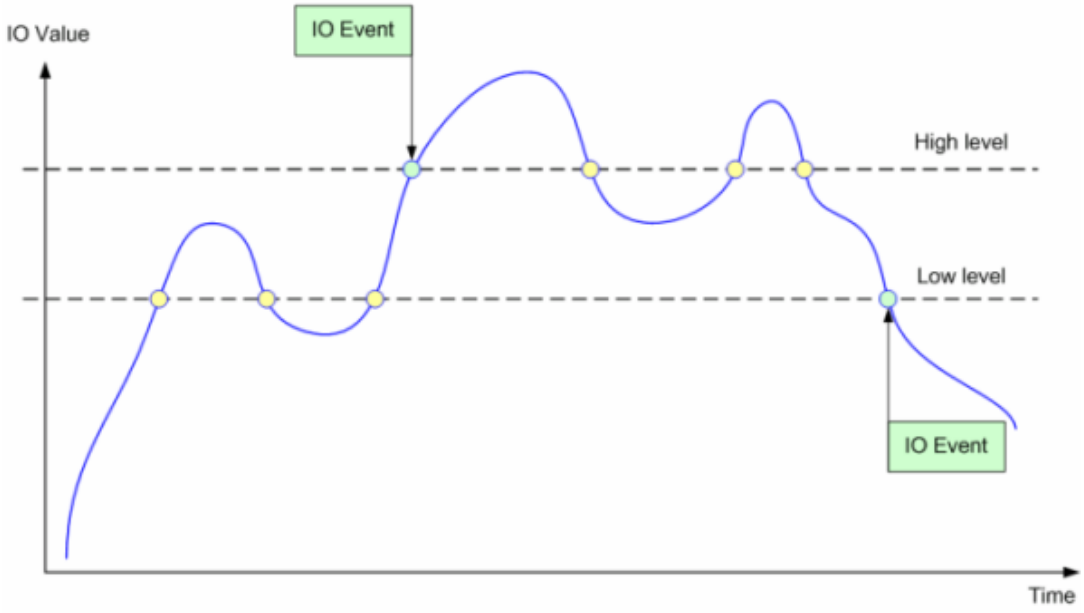


Figure 31. Event generation according hysteresis algorithm

6 SMS COMMAND LIST

Read chapter 5.10 to know how to construct proper SMS message and send it to FM1100 device. All commands are case sensitive. While FM1100 operates in Deep Sleep mode and user tries to send SMS message it could not arrive to FM1100 device, because GSM/GPRS module is disabled most of the time (wake up depends on Send Period parameter). It is recommended to wait until FM1100 is not in Deep Sleep mode.

6.1 SMS command list

Command	Description	Response
getstatus	Modem Status information	Yes
getweektime	Current device time, Day of Week and amount of minutes passed since start of week	Yes
getops	List of currently available GSM operator	Yes
getcfgtime	Date and Time of last successful configuration	Yes
getgps	Current GPS data and time	Yes
cpureset	Reset CPU	No
resetprof	Reset all FLASH1 profile to default profile	No
getver	Device / Modem / Code version information	Yes
getinfo	Device runtime system information	Yes
deleterecords	Delete all records saved on FLASH	No
getio	Readout digital inputs and outputs	Yes
readio #	Readout input value according entered ID, # - ID value	Yes
setdigout ##	set digital outputs 0 – OFF, 1 – ON DO1 DO2 DO3 DO4	Yes
getparam #	Readout parameter value according entered ID. # - ID value.	Yes
setparam # #	Set parameter value according entered ID and Value. 1.# - ID value. 2.# - New Parameter Value	Yes
flush #,#,#,#,#,#,#	Initiates all data sending to specified target server 1.# - IMEI 2.# - APN 3.# - LOGIN 4.# - PASS 5.# - IP 6.# - PORT 7.# - MODE (0-TCP/1-UDP)	No

6.1.1 getstatus

Response details	Description
Data Link	Indicate module connection to server at the moment: 0 – Not connected, 1 – connected
GPRS	Indicate if GPRS is available at the moment
Phone	Voice Call status: 0 – ready, 1 – unavailable, 2 – unknown, 3 – ringing, 4 – call in progress, 5 – asleep
SIM	SIM Status: 0-ready, 1-pin, 2-puk, 3-pin2, 4-puk2
OP	Connected to GSM Operator: numerical id of operator
Bat	Battery charge level [0-5] (NOT APPLICAPABLE for FM1100)
Signal	GSM Signal Quality [0-5]
Service	(NOT APPLICAPABLE for FM1100)
NewSMS	Indicate if new message received
Roaming	0 – Home Network, 1 – roaming
SMSFull	SMS storage is full? 0 – ok, 1 – SMS storage full

Example: Data Link: 0 GPRS: 1 Phone: 0 SIM: 0 OP: 24602 Bat: 4 Signal: 5 Service: 1 NewSMS: 0 Roaming: 0 SMSFull: 0

6.1.2 getweektime

Response details	Description
Clock Sync	Indicates system clock synchronization status. 0 – System is not synchronized, 1 – System synchronized
DOW	Day Of Week – indicates current day of week starting from 0 – Monday, 1 – Tuesday, etc.
Time	Indicates current GMT time
WeekTime	Indicates time in minutes starting from Monday 00:00 GMT

Example: Clock Sync: 1 DOW: 4 Time 12:58 Weektime: 6538

6.1.3 getops

Response details	Description
LIST	Returns list of current available allowed operators.

Example: GSM OP LIST: 0. 24602

6.1.4 getcfgtime

Response details	Description
Date/Time	Returns last performed configuration date and time.

Example: Last Configuration was performed on: 2010.4.15 5:45:19

6.1.5 getgps

Response details	Description
GPS	Indicates valid (1) or invalid (0) GPS data
Sat	Count of currently available satellites
Lat	Latitude (Last good Latitude)
Long	Longitude (Last good Longitude)
Alt	Altitude
Speed	Ground speed, km/h
Dir	Ground direction, degrees
Date	Current date
Time	Current GMT time

Example: GPS:1 Sat:7 Lat:54.71473 Long:25.30304 Alt:147 Speed:0 Dir:77 Date: 2007/8/24 Time: 13:4:36

6.1.6 getver

Response details	Description
Code Ver	Firmware version
Device IMEI	IMEI
Device ID	Device ID is used to detect by server which type of configuration to load
Modem App Ver	Version of modem application
Modem REV Ver	Modem Firmware version

Example: Code Ver:0.48.17 Device IMEI:353976010139156 Device ID:000001 Modem APP Ver:2007.11.07 Modem REV Ver:04.13.00

6.1.7 getinfo

Response details	Description
INI	Device Initialization Time
RTC	RTC Time
RST	Restart Counter
ERR	Error Counter
SR	Number of Sent Records
BR	Number of broken records
CF	Profile CRC Fail counter
FG	Failed GPRS counter
FL	Failed link counter
UT	UPD Timeout counter
SMS	Sent SMS Counter
NOGPS	No GPS Timer
GPS	GPS receiver state. 0 – OFF, 1 – restarting, 2 – ON but no fix, 3 – ON and operational, 4 – sleep mode
SAT	Average satellites
RS	Reset Source Identification

MD	Data Mode state. 0 – Home and Stop, 1 – Home and Moving, 2 – Roaming and Stop, 3 – Roaming and Moving, 4 – Unknown and Stop, 5 – Unknown and Moving

Example: INI:2007/8/24 10:15 RTC:2007/8/24 12:43 RST:2 ERR:11 SR:182 BR:0 CF:0 FG:0 FL:0 UT:0 SMS:2 NOGPS:0:0 GPS:3 SAT:7 RS:7 MD:0

6.1.8 getio

Response details	Description
DI#	Digital Input state
DO#	Digital Output state

Example: DI1:0 DI2:0 DO1:0 DO2:0

6.1.9 readio

Response details	Description
ID	I/O element ID
Value	I/O Element value

Example: IO ID:3 Value:0

6.1.10 setdigout

Sets digital outputs to ON or OFF state. Value is written as a row for OUT1 and OUT2 values.

Example: ‘setdigout 01’ will set OUT2 to high level, while OUT1to low level.

6.1.11 getparam

Read parameter value. ID consists of 4 digits – first digit identifies profile, second, third and fourth identifies parameter ID as described in Parameter List chapter.

Response details	Description
ID	Profile number and parameter ID
Value	Parameter value

Example: ‘getparam 1245’ command will request server IP address in profile1.

6.1.12 setparam ####

Sets new value for parameter. ID consists of 4 digits – first digit identifies profile, second, third and fourth identifies parameter ID as described in Parameter List chapter. In value field a new parameter value is entered.

Example: ‘setparam 1245 127.0.0.1’ will change configured IP address in profile1 with new value

6.1.13 flush #,#,#,#,#,#,#

Initiates all data sending by GPRS to specified target server. Comma separated parameters go as numbered:

1.# - IMEI
2.# - APN
3.# - GPRS LOGIN
4.# - GPRS PASSWORD
5.# - IP
6.# - PORT
7.# - MODE (0-TCP/1-UDP)

Parameters are separated by comma (no spaces needed). In case you don't need to enter parameter (Login/Pass) – do not put space, simply put comma and write next parameter.

Example: opa opa flush 353976012555151,banga,,,212.47.99.62,12050,0

Response details	Description
FLUSH SMS Accepted	FLUSH SMS Accepted
# records found on FLASH	Number of records found on FLASH
Minimum Records to Send: #	Number of minimum saved records to send
GPRS Enabled: #	State of the GPRS connection, 0 – disabled; 1 – enabled
Time Sync: #	Indicates time synchronization on the device, 0 – not synchronized; 1 – synchronized

Example: FLUSH SMS Accepted. 11 records found on FLASH. Minimum Records to Send: 1. GPRS Enabled: 1. Time Sync: 1.

7 Debug mode

FM1100 is able to transmit its current state when connected to PC using USB cable. It is used to detect errors and provide information to possible solutions when operating as unexpected. Download Terminal from: http://avl1.teltonika.lt/Downloads/Software/Terminal.zip.

After launching terminal choose baud rate 115200 and hardware control – none. Select COM port which is assigned to "Virtual COM Port". Click on 'Start Log' button and save a new file. Then click 'Connect' to start receiving messages from FM1100.

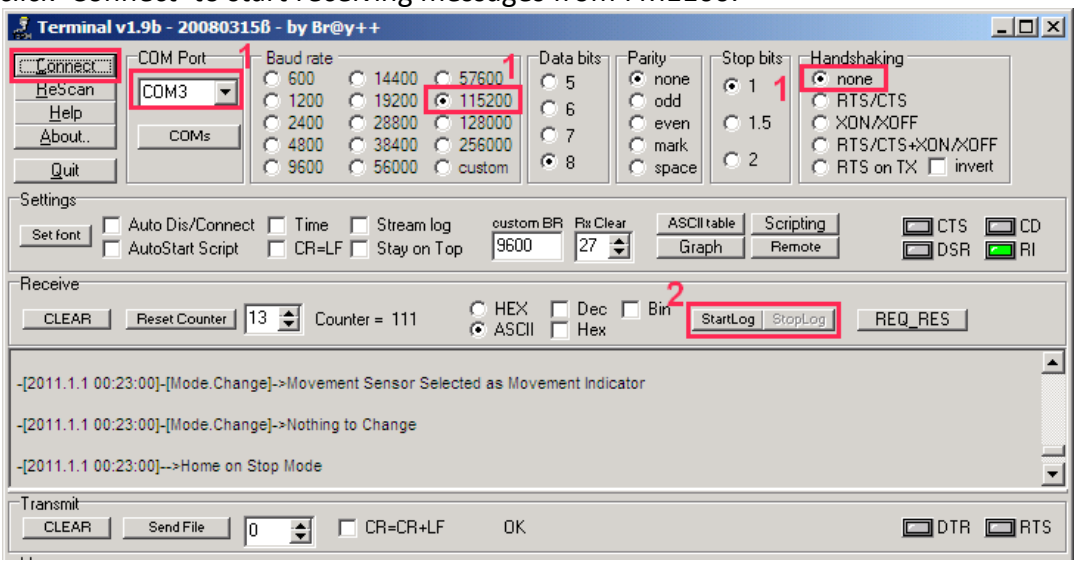


Figure 32. Terminal window

8 MOUNTING RECOMMENDATIONS

8.1 Connecting Wires

- Wires should be connected while module is not plugged in.
- Wires should be fastened to the other wires or non-moving parts. Try to avoid heat emitting and moving objects near the wires.
- The connections should not be seen very clearly. If factory isolation was removed while connecting wires, it should be applied again.
- If the wires are placed in the exterior or in places where they can be damaged or exposed to heat, humidity, dirt, etc., additional isolation should be applied.
- Wires cannot be connected to the board computers or control units.

8.2 Connecting Power Source

- Be sure that after the car computer falls asleep, power is still available on chosen wire. Depending on a car, this may happen in 5 to 30 minutes period.
- When module is connected, be sure to measure voltage again if it did not decrease.
- It is recommended to connect to the main power cable in the fuse box.

8.3 Connecting Ignition Wire

- Be sure to check if it is a real ignition wire – power does not disappear while starting the engine.
- Check if this is not an ACC wire (when key is in the first position, most electronics of the vehicle are available).
- Check if power is still available when you turn off any of vehicles devices.
- Ignition is connected to the ignition relay output. As alternative, any other relay, which has power output, when ignition is on, may be chosen.

8.4 Connecting Ground Wire

- Ground wire is connected to the vehicle frame or metal parts that are fixed to the frame.
- If the wire is fixed with the bolt, the loop must be connected to the end of the wire.
- For better contact scrub paint from the place where loop is connected.

8.5 Connecting Antennas

- When placing antennas avoid easily reached places.
- Avoid GPS antenna placement under metal surfaces.
- Avoid placing FM1100 device near car radio, speakers or alarm systems.
- GPS antenna must be placed so its state is as horizontal as possible (if antenna is leant more than 30 degrees, it is considered incorrect mounting).
- GPS antenna cable cannot be bent more than 80 degrees.
- GPS antenna must be placed sticker facing down

Figure 33 GPS antenna correct mounting.

It is recommended to place GPS antenna behind dashboard as close to the window as possible. A good example of GPS antenna placement is displayed in a picture below (area colored green).

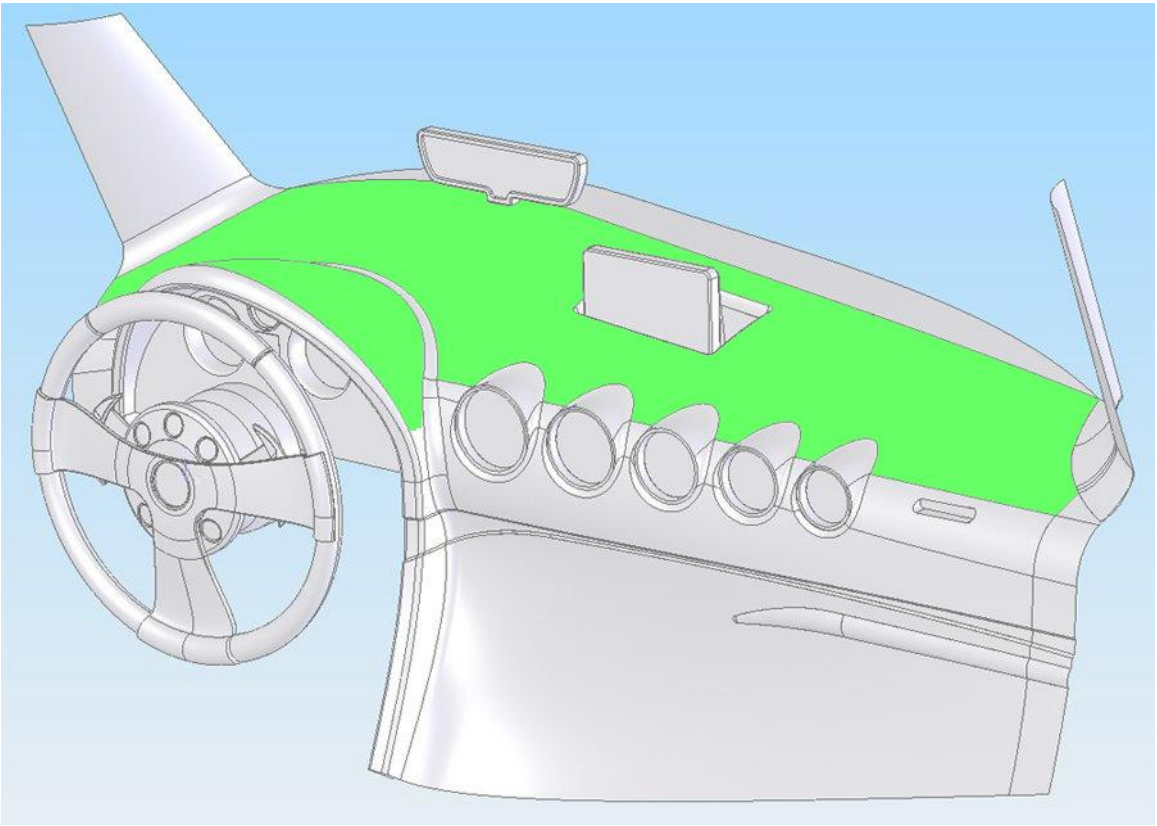


Figure 34. Correct placement of FM1100

8.6 Module Installation

- Module should not be seen or easily reached.
- Module should be firmly fixed to the surface or cables.
- Module cannot be fixed to heat emitting or moving parts.
- SIM card should be inserted in the module while the connector is plugged off (while module has no power).

9 CHANGE LOG

Nr.	Date	Version	Comments
1	2011-04-15	0.3	Preliminary draft release.
2	2011-04-20	0.4	Preliminary draft release update.
3	2011-04-21	0.5	Preliminary draft release update.
4	2011-04-26	0.6	Preliminary draft release update.
5	2011-04-27	0.7	Preliminary draft release update.